# Syllabus

## Course description

<table>
<thead>
<tr>
<th>Course title</th>
<th>Reverse Engineering and Rapid Prototyping</th>
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<tbody>
<tr>
<td>Course code</td>
<td>47502</td>
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<tr>
<td>Scientific sector</td>
<td>ING-IND/15</td>
</tr>
<tr>
<td>Degree</td>
<td>Master in Industrial Mechanical Engineering</td>
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<tr>
<td>Semester</td>
<td>1</td>
</tr>
<tr>
<td>Year</td>
<td>I</td>
</tr>
<tr>
<td>Academic year</td>
<td>2016/17</td>
</tr>
<tr>
<td>Credits</td>
<td>5</td>
</tr>
<tr>
<td>Modular</td>
<td>No</td>
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**Total lecturing hours**: 24  
**Total lab hours**: 24  
**Total exercise hours**: -  
**Attendance**: Extremely Recommended  
**Prerequisites**: None  

### Specific educational objectives

The course addresses the fundamental issues dealing with methods and techniques to support engineering design processes focusing on the opportunities provided by Reverse Engineering and Rapid Prototyping. The contents of the teaching are characterizing for the students of the M.Sc. course. Students will achieve first a global understanding of product development processes. Then, the course will clarify the design phases and the circumstances in which Reverse Engineering and Rapid Prototyping are the most advantageous. Within the contents, a discussion about alternative technologies will be introduced. Students will have the opportunity to make experiments by directly using the available tools in a lab setting. The course will illustrate the most recent findings concerning Reverse Engineering and Rapid Prototyping.

### Lecturers

- **Dr. Yuri Borgianni**, K0.05  
  yuri.borgianni@unibz.it

- **Dr. Pasquale Russo Spena**, K1.12  
  pasquale.russospena@unibz.it

### Scientific sector of the lecturers

- ING-IND/15 (Dr. Yuri Borgianni)  
- ING-IND/16 (Dr. Pasquale Russo Spena)

### Teaching language

- English

### List of topics covered

- Introduction to New Product Development
- Tasks of detailed design, new frontiers of
## Computer-Aided Design tools

- Reverse Engineering
  - Objectives and common application fields
  - Existing technologies
  - Contact systems
  - Contactless systems
  - Manipulation of acquired data
  - Practical experiences
- Introduction to the Basic Principles of Additive Manufacturing.
- Additive Manufacturing technologies of polymers:
  - Introduction to polymers materials and properties
  - Stereolithography (SLA)
  - Solid Ground Curing (SGC)
  - Fused Deposition Modelling (FDM)
  - Laminated Object Manufacturing (LOM)
  - Selective Laser Sintering (SLS)
  - Polyjet
  - Three Dimensional Printing (3DP)
  - Multi Jet Modelling (MJM)
  - Ballistic Particle Manufacturing (BPM)
  - Drop On Demand (DOP)
- Additive Manufacturing technologies of metals:
  - Selective Laser Melting (SLM)
  - Electron Beam Melting (EBM)
  - Laser Engineered Net Shaping (LENS)
- Additive Manufacturing technologies of ceramics and composites
- Rapid Tooling

<table>
<thead>
<tr>
<th>Office hours</th>
<th>Monday to Friday, upon appointment to be agreed through email</th>
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<tr>
<td>Teaching format</td>
<td>The course is based on frontal lectures, classroom and laboratory activities, as well as exercises on industrial case studies. The topics of the course are reported in the lecture notes provided by the professors, as well as in the textbooks of the bibliography. After each lecture, the corresponding pdf presentation will be posted in the Reserve Collection database. The professors can also provide additional material (e.g., research papers, notes). The professors can be contacted by students for questions and clarifications by appointment.</td>
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<th>Learning outcomes</th>
<th>Knowledge and understanding</th>
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<tr>
<td>Students will</td>
<td>acquire basic knowledge about the main issues about Reverse Engineering and Rapid Prototyping</td>
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tools, representing an opportunity to conduct the
detailed design of products through cutting-edge
technologies;
ii. understand the main differences, pros and cons of
the alternative technologies to carry out design
tasks supported by 3D-printing devices
iii. acquire knowledge about some important Additive
Manufacturing processes used for the fabrication
of prototypes and components;
iv. be able to identify the advantages and limitations
of Reverse Engineering and Additive
Manufacturing processes in the overall context of
design, manufacturing and industrial engineering.

Applying knowledge and understanding
Students will have the ability to apply their knowledge to
select and employ Reverse Engineering and Rapid
Prototyping techniques in the Mechanical Engineering
field. The group exercises in the classroom and in the
laboratory through hands-on experiments, progress tests,
conversations with the professors and the performance in
specific tasks would allow to assess and evaluate the
students' ability to apply their knowledge and
understanding of the topics covered during the course.

Making judgements
Students will be able to compare the existing tools that
have been developed for 3D scanning and Additive
Manufacturing. They will develop critical capabilities about
the pros and cons regarding said instruments. In addition,
they will be able to explain alternative strategies for
achieving the results obtained through Reverse
Engineering and Rapid Prototyping.

Communication skills
Students will have the ability to structure and prepare
scientific and technical documentation pertaining to the
fundamentals of Reverse Engineering and Rapid
Prototyping. Moreover, they will have the ability to
present, communicate and critically discuss the topics
covered during the course.

Learning skills
Students will be able to combine the knowledge acquired
during the course with respect to the theoretical
background of the teaching, the experience matured
through lab tests and notions about trends in the field,
gained through the recent literature in the domain.
Students will have the opportunity to extend the
knowledge of the topics of the course by consulting
scientific literature, specialized texts, technical standards
and international standards that the professors will provide during the course.

| Assessment | The assessment will be based on a final exam (2/3) and the active participation of the students in the lab activities (1/3).

The final exam is an oral examination. The oral exam will be substituted by an equivalent written test in case that a large number of students will participate in the exam session. The final exam consists in questions to assess the knowledge and understanding of the topics of the course and the ability of the student to present, communicate and discuss the detailed design phase of engineering design cycles, by favorably implementing Reverse Engineering and Rapid Prototyping techniques.

During the lab activities, the students will have to demonstrate their capability to work with Reverse Engineering and Rapid Prototyping devices in a profitable way. |

| Assessment language | English |
| Evaluation criteria and criteria for awarding marks | The evaluation criteria of the oral exam are based on the knowledge of the topics of the course, the clarity of the response and the appropriateness of the language of the student (with regard to the language of the course), the pertinence and the relevance of the response and the autonomy of judgment, as well the capability of critically selecting alternatives for product development. |

| Required readings | The course material is mainly collected from research papers and web notes. Students can also refer to the following textbooks (even if not exhaustive of the whole course):

| Supplementary readings | Additional textbooks, lecture notes, and research papers will be suggested by the professors during the course. |